

# Fudan Extracurricular Lives

## [Background]

Students in Fudan University have various extracurricular lives. It seems to be widely known that many students in the Zhangjiang Campus prefer **Tractor** (a game of poker with four players, also named as "80-points" or "Upgrading"), but it is true that a considerable mass of students (especially in Department of Computer S&T) love another four player game, Mahjong, very much. Mahjong is one of the most historied multiplayer games in China. People in several provinces prefer this game most with various modified rules respectively.

To begin this problem, firstly, we shall introduce some basic concepts about the game:

### ● Game Going

The game of Mahjong is played with a special set of "Mahjong Tiles", which made by piece of wood or stones, each tile have a corresponding image on one face, which denotes particular signification. Initially, all tiles should be randomly shuffled and put into a pile with their (tiles') faces down, thus all their contents are hidden. After that, the participating players each get 13 tiles as there **Holding Tiles** (will be definitely explained and discussed later). Consequently, players come to the "Dealing Section" that everyone alternatively gets one tile from the hidden pile and includes it into this player's Holding Tiles, then chooses one tile from the current **Holding Tiles** to discard. This procedure will continue until there's no tile in the hidden pile or any player meet the **Win** condition (Practically, there are further modified rules such as "Bloody Battle", which pronounced as "Shyue-Chan" in Chinese, will break this traditional rule, but we do not take them into account in this problem).

### ● Holding Tiles

In the process of game, players should manage their own set of tiles; these tiles are considered as **Holding Tiles** of each player respectively. **Holding Tiles** of one player have two particular types: **Declared** and **Hidden**. **Declared Tiles** are shown into public while **Hidden Tiles** are kept private, thus one can know all the four players' **Declared Tiles** but only his or her own **Hidden Tiles**. The event causing **Hidden Tiles** into **Declared** will be discussed later.

### ● Win

Before introducing the concept of how to **Win** a game, we have to firstly give out two essential sub-concepts, please remember that they are quite important for solving this problem:

#### (a) Architecture

A player's Holding Tiles are just a set of tiles, they can be separated and assembled into special **Components**, and all these **Components** compose the **Architecture** of **Holding Tiles**.

#### (b) Analysis

The procedure and method to determine the **Architecture** of one's **Holding Tiles**

is called **Analysis** (please ignore the changing part of speech). **Analyzing** one's **Holding Tiles** should be based on a system of related rules and might be somewhat complex and tricky, discussed later.

In the rules of Mahjong, the **Target Architecture** will be defined. As the name implies, if a player's **Holding Tiles** can be **Analyzed** into a particular **Architecture** coinciding the **Target Architecture**, then this player can **Win** the game.

- **Score**

After one player **Win** a game, the score of this **Win** should be judged under a scoring rules system. The score is used for determining the worth of this **Win** -- It is widely known that Mahjong is originally invited for gambling.

[Description]

Now in China, people in Sichuan Province prefer the game of Mahjong much more than people in other area; causally, most of students in Fudan University who prefer Mahjong come from Sichuan. To this reason, we would like to use the rule of Sichuan Mahjong to go on this problem. With related to the traditional Mahjong rule, regulation of this game in Sichuan Province have been changed most obviously in the following two ways:

- **Tiles simplification**

In the original rule of Chinese Mahjong, the game is based on a large set of tiles. All these tiles can be classified into several **Categories** -- including **Simple Category**, **Honor Category**, and **Bonus Category** -- with different functions when the game playing. The last two kinds of **Categories** are used in rules of some other area of China. (In other words, has nothing to do with this problem) Sichuan Mahjong only uses **Simple Category** in the game:

There are three different **Suits** in **Simple Category** and each **Suit** is numbered 1 to 9. They are **Dots**, **Bamboo** and **Myriads**.

**Dots** numbered 1 to 9.




**Myriads** numbered 1 to 9.





**Bamboo** numbered 1 to 9.



There are four matching tiles for each value (e.g. there are four Dots tiles with the number 2). Generally, there are two essential aspects of information for determining the **Kind** of a tile: the **Suit** and **number**, thus we can uniquely name a

tile with its order of **number** and **Suit**, for example: name  as "Third Bamboo"

and name  as "First Dots". Uniquely, players always call  (First Bamboo) as "Yao-Jhee". It is easy to calculate that there in total 108 tiles used in the game of Sichuan Mahjong, that is, there are nine kinds in each suit and four tiles of each **Kind**.

- **Two Suits Limitation**

This limitation constrains that at most two suits are permitted in one's **Holding Tiles**, that is, one with all the three suits in the **Holding Tiles** can never **Win** a game (Actually, would cause some penalty).

After clarifying these modifications, we can go on the description of Mahjong game.

During the process that every player gets new tiles alternatively, there are some situations which would cause case of **Interruption**. In detail, the rule of Mahjong allows players to meld ("meld" is a conventional glossary in Mahjong game, it is better to understand it as "adopt") tiles discarded by others and, after that, sometimes discard a **Holding Tiles** for exchange. In order to explain the concept of **Interruption** and the way to **Win** the game, we shall now define some concepts of **components** (we've mentioned before but never defined) of **Holding Tiles**. Please review the concept of **Target Architecture**, a **Target Architecture** is composed by a set of **Components**, and there are two kinds of **Components**:

- **Sentence**

There are two kinds of sentences:

(a) **Sequence**

A **Sequence** is a triple of tiles with sequential number, for example:



There must be no skipping of numbers, nor does 9 loop around to 1. **The sequence must be in the same Suit.**

(b) **Chunk**

A **Chunk** is a triple of tiles with identical number, for example:



There **Chunk** must be in the same suit.

- **Pair**

Similar to **Chunk**, A **Pair** is a couple of (two) tiles with identical number and same suit, see the following example:



With the definition of **Component**, there are three ways of melding others' discarded tiles, and each time if a player calls for a melding, then an **Interruption** was made. However, only two ways of **Interruption** are used in rule of Sichuan Mahjong:

- **Refine** (pronounced as "Pong" in Chinese)  
 If someone discards a tile while you have a **Pair** of the same tile in your **Hidden Tiles**, you may (but not must) **Refine** the discarded tiles with the pair in your hand, **after that these three identical tiles should become Declared**. As we have mentioned before, each time you **Refine** a tile, you should discard another **Hidden Tile** for exchange.
- **Upgrade** (pronounced as "Kong" in Chinese)  
 If you have got a sentence of **Chunk** in **Hidden Tiles** while another player discards the identical (in fact, the only one) tile -- or you get this only identical tile by yourself -- you may (but not must) **Upgrade** the **Chunk** into a **Component** with four same tiles (a "Kong") by melding the discarded tile. The same with **Refining**, after **Upgrading** these four identical tiles should become **Declared**. Specially, when making an **Upgrade**, you should never discard another **Hidden Tiles**. It seems that after an **Upgrade**, an extra tile is merged into one's **Holding Tiles** (Accurately, into **Declared Tiles**), in fact these four same tiles should also be considered as a **Chunk**, the extra tile is only for "honor", which means being used for calculate the score but never used when Analyzing the Architecture.

According to the descriptions of **Refine & Upgrade**, we can consequently conclude that:

- **Declared Tiles** of a player always come from one or more melding **Interruptions**.
- Once a tile becomes **Declared**, it will never be back to **Hidden** and never be discarded any more.

Another type of **Interruption** is **Win** - Which has been defined above -- that is, once another player discards a particular tile, or you get such a tile by yourself, if you can merge such a tile into your **Holding Tiles** and then **Analyze** all the **Holding Tiles** (14 tiles now) as a **Target Architecture**, then you can **Win** this game. Now, we should give the detailed explanation of **Target Architecture** under the rule of Sichuan Mahjong. The **Target Architecture** of **Holding Tiles** can be considered as that:

- Following the Two Suits Limitation.
- **Components** in the **Architecture** fits one of the following two structural styles:
  - (a) Consist of FOUR **Sentences** and ONE **Pair**, here we name the unique **Pair** as "Jong".  
 We name this style as **Regular Target**.
  - (b) Consist of SEVEN **Pairs**.

Remember that the **Declared Tiles** is a group of **Sentences** (an **Upgraded Chunk** can be considered as an ordinary **Chunk** with "honor" for scoring, discussed later). When Analyzing the Holding Tiles, the Declared Tiles and Hidden Tiles must be considered

separately and can never be mixed; furthermore, **Declared Tiles** can only be **Analyzed** as several **Chunks** (ordinary **Chunk** or **Upgraded Chunk**) but never **Sequences**. To finish a **Target Architecture**, we need 14 tiles, (ignored extra tile from **Upgrading**), however, each one has only 13 **Holding Tiles**. Therefore, players always need another extra tile to complete the **Architecture**; this situation gives the concept of **Expected Tile**: If a player's **Holding Tiles** can fit the **Target Architecture** by adding a particular and **existing** tile, then such a tile is considered as one of the player's **Expecting Tiles**. Pay attention on the word "existing" please: that is, if you have held all such existing (four) tiles, then this kind of tile cannot be considered as Expected Tile.

Now we come to specify the rule of **Scoring**: once a player meets the **Target Architecture** (has got **Win**), he or she will have the basic score of ONE, that is, the lowest score of a **Win** is ONE. In addition, there are lots of specific conditions for awarding further extra scores. See the following items for description:

- **Dragon** (pronounced as "Kong" and "Gher" in Chinese, especially in Chengdu dialect)

If a player has collected all the four tiles of same kind of tiles in his or her **Holding Tiles**, then we say this kind become a **Dragon**. Each **Dragon** gives the owner ONE additional score.

Apparently, once a player making an **Interruption of Upgrade**, a **Declared Dragon** is created, but there's another situation: sometimes player shows a **Declared Chunk** in **Declared Tiles** but hides the rest one of that kind of tiles in **Hidden Tiles**, or even hides all the four same tiles in **Hidden Tiles**, these two cases will also be acknowledged as **Dragon**.

- **Seven Couples** (pronounced as "Chee Dwee" in Chinese)

If the **Architecture** meets the second style of **Target Architecture** - in other words: consists by seven pairs - then such an **Architecture** can be identified as **Seven Couples**, this special style gives the owner TWO additional score.

- **Purely** (pronounced as "Ching Yi-Seh" in Chinese)

If one players all **Holding Tiles** (Attention, not only the **Hidden** or **Declared Tiles**) have the same **Suit**, then **Purely** can be identified, TWO additional score awarded.

- **Chunkious** (pronounced as "Dwee-Tsi Hoo" in Chinese)

**Chunkious** is a special style of **Regular Target**, the condition is that all sentences of **Holding Tiles** are **Chunks**, **Sequence** never appears. **Chunkious** is worth ONE additional score.

- **Sky-ground Related** (pronounced as "Tai Yao-Jhew" in Chinese)

This is a very unique and confusing rule in Sichuan Mahjong, even not all players in Sichuan admit this condition, but in this problem we take it into account for generalization.

No matter what style of **Target Architectures**, the condition of **Sky-ground Related** asks each components in the **Architecture** have at least one tile has

numbers of 1 or 9. For instance, the following components are acceptable:



This special style gives the owner TWO additional scores.

- **Royal Chunkious** (pronounced as "Jong Dwee" in Chinese)

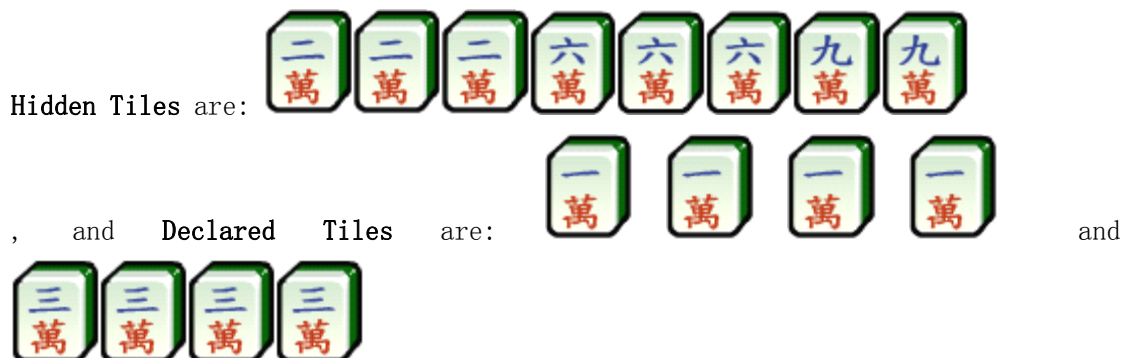
As the name implies, the **Royal Chunkious** is a special style of **Chunkious**, thus if an Architecture does not meet the condition of **Chunkious**, it can never be judged as **Royal**. This style means in an Architecture of **Chunkious**, only tiles with numbers 2, 5 and 8 appear. As examples, the following components are valid:



**Royal Chunkious** worth TWO **more** scores **than** normal **Chunkious**.

- There are some other items relating to Scoring such as Seizing ("Chiang Kong"), Lucky Flower ("Kong Hsiang-Hwa"), but are not considered in this problem.

In order to solve this problem, the concept of **CONSISTENCE** might be somewhat a critical logic. We've just listed all the special situation causing extra scores for the **Winning** player, you may come up with the idea that some of them can occur simultaneously, for example, the following **Holding Tiles** (has Won):



This set of Holding Tiles can be obviously **Analyzed** as an **Architecture** which meeting the condition of **Chunkious**, **Purely** and double **Dragons** (just **Analyze** as how they are displayed in the example), and worth  $1(\text{basic}) + 1(\text{Chunkious}) + 2(\text{Purely}) + 1(\text{Dragon}) * 2 = 6$  scores.

However, when we consider another example:

**Hidden Tiles** are (there is no **Declared Tiles** in this example):



At first glance, we can **Analyze** them as an **Architecture** fitting rule of **Seven Couples**, which is trivial; yet we can also **Analyze** them in another way (fitting the rule of

Sky-ground Related) :



This way, can we judge the score as  $1(\text{basic}) + 2(\text{Seven Couples}) + 2(\text{Sky-ground Related}) = 5$ ? The answer is negative. For explaining this paradox, please remind yourself to notice the definition of **Win**: a player gets Win means he or she can **Analyze** the **Holding Tiles** into a **Target Architecture**, when we calculate the score, we are in fact aiming at such an resulting **Architecture**, scilicet, scoring is based on a particular **Architecture** but not based on the set of **Holding Tiles**, that is, if a set of **Holding Tiles** can be **Analyzed** as more than one **Target Architectures**, they are independent when scoring and cannot merge. Now we can give the correct answer of the last example: if **Analyze** in first way, then  $1(\text{basic}) + 2(\text{Seven Couples}) = 3$ ; otherwise, if use the second way, then  $1(\text{basic}) + 2(\text{Sky-ground Related}) = 3$ , therefore the final score should be considered as 3. The last remaining confusion of **scoring** is that: if two or more **Analyzed Architecture** has different scores, which should be the delegate? The policy for dealing with this question is totally determined by real players, in this problem we choose the higher one - we choose the highest possible score among all **Analyzed Target Architecture**.

Your task in this problem is: given a player's **Holding Tiles**, please determine all this player's **Expected Tiles** (if exists) and their corresponding scores.

#### [Input]

The first line of input file is a integer T ( $T \leq 100$ ) indicating number of test cases, then T lines are following. Each line describes a case of **Holding Tiles**: two separated strings, the first string giving the **Hidden Tiles** and the second one giving the **Declared Tiles**. If there are no **Declared** ones, the second string would be "NONE" (quotes for clarity). Each tile contains two characters, the first one is a digit character which indicates this tile's number and the second is a capital letter within 'D', 'B' and 'M', that 'D' for **Dots** and 'B' for **Bamboo** and 'M' for **Myriads**, indicating tile's **Suit**. For example, "7M" means **Seventh Myriad** and "1B" means **First Bamboo** (also known as "Yao-Jhee"). You may assume that all the input cases are valid in the rule of Sichuan Mahjong.

#### [Output]

For each case, firstly output a single line containing the case number counting from 1. Then, if there's no **Expected Tiles**, output a single lines containing string of "NONE" (quotes for clarity); otherwise, output all the player's **Expected Tiles** (with the same format of input) and then output their corresponding scores after each **Expected Tiles**, separated with a colon (":") and a space. All the **Expected**

Tiles are printed in separated lines. Any extra blanks (spaces or empty lines) will cause "Wrong Answer". The outputted **Expected Tiles** should be sorted in this way: first sorted by **Suits**, 'D' at first and then 'B' and 'M' in the last; second sorted by their numbers, smaller number has higher priority.

**[Example]**

**Input:**

```
7
8D8D8D5D2D2D2D 6D6D6D7D7D7D
8D8D8D5D2D2D2D6D6D6D7D7D7D NONE
1D1D1D1D 3D3D3D4D4D4D5D5D5D
2D2D2D5D5D5D2M2M2M5M5M8M8M NONE
1D1D1D1D2D2D2D2D3D3D3D3D9M NONE
1D1D1D1D9D9D9D9D1M1M1M9M NONE
2D2D3D3D4D5D5D6D6D7D7D8D8D NONE
```

**Output:**

```
Case #1:
5D: 4
Case #2:
4D: 3
5D: 4
6D: 4
7D: 4
8D: 4
Case #3:
NONE
Case #4:
5M: 4
8M: 4
Case #5:
9M: 6
Case #6:
9M: 8
Case #7:
1D: 3
4D: 5
```

**[Hints]**

Consider the third case of sample input, it seems that adding a tile "1D" may construct the Target Architecture, however, there does not exist another "1D" in all the tiles.